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EXAMINER	
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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/080,449	Applicant(s) BLAKE ET AL.	
	Examiner Anthony Mackowey	Art Unit 2623	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 2/22/02.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-38 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-38 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 22 February 2002 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 5/19/03.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

Claim Objections

Claims 1 and 32 are objected to because of the following informalities:

Claim 1 recites, "a representative cluster at a cluster center". Examiner believes this to be a typographical error and should be replaced with "a representative exemplar at a cluster center" as recited in the specification and other claims.

Claim 32 recites, "A computer-readable medium having computer executable instructions for automatically tracking patterns in a set of tracking data, said computer executable instruction comprising". This is incorrect because a computer does not execute instructions. Examiner suggests replacing with "A computer-readable medium storing a program for causing a computer to perform a method for automatically tracking patterns in a set of tracking data, said method comprising the steps of".

Appropriate correction is required.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1,2,8,11,12 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,703,964 to Menon et al. (Menon) in view of U.S. Patent 6,307,965 to Aggarwal et al. (Aggarwal).

As to claim 1, Menon discloses, a system (col. 6, line 35) for automatic probabilistic pattern tracking (col. 1, lines 29-31, Menon teaches a pattern recognition system for recognizing input data patterns from a subject and classifying the subject) comprising:

automatically learning a set of exemplars from at least one set of training data (col. 6, lines 35-48, Menon teaches receiving training data patterns in the form of feature pattern vectors.);

clustering the exemplars into more than one cluster of exemplars (col. 6, line 50 thru col. 7, line 31, Menon teaches determining which cluster to place the feature vector in or else creating a new cluster if there is no correlation.);

generating an observation likelihood function for each exemplar cluster (col. 3, lines 1-11,41-48, Menon teaches creating training class histograms which are used in determining the classification of the subject.) based on a computed distance between exemplars in each cluster (col. 1, lines 38-43, Menon teaches a correlation or distance is computed between the training pattern and the category and added to a cluster of the category.);

providing the exemplar clusters, observation likelihood functions, and target data to a probabilistic tracking function (col. 3, lines 1-18,41-48); and

probabilistically tracking at least on pattern in the target data by using the exemplar clusters, observation likelihood functions, and target data to predict at least one target state (col. 3, lines 41-48, Menon teaches classifying the subject in a known class or classifying it unknown.)

Menon is silent with regard to each cluster having a representative exemplar at a cluster center. However, Aggarwal teaches using the k-medoid method to form clusters of information in which the medoids are used as anchor data values (representative exemplar at center) about which the clusters are detected (col. 5, lines 43-44).

The teachings of Menon and Aggarwal are combinable because they are both concerned with clustering of information. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have the system taught by Menon perform the clustering operation according to the k-medoid process (which inherently includes a representative exemplar at the center of each cluster) as taught by Aggarwal. One would have been motivated to do this because feature picking is not performed in advance, thus avoiding loss of information (Aggarwal, col. 2, lines 26-28).

As to claim 2, Menon does not disclose clustering of exemplars is achieved using an iterative k-medoids clustering process based on a computed distance between the representative exemplar at the center of each cluster and each of the exemplars clustered with that exemplar. However, Aggarwal teaches a k-medoid clustering process in which data values are assigned to a medoid according the distance measure between the data value and the medoid (col. 7, lines 26-33). Aggarwal also teaches the clustering process is iterative in order to determine the best set of medoids (col. 5, line 62 thru col. 6, line 23).

It would have been obvious to one of ordinary skill in the art at the time the invention was made for the system taught by Menon to use an iterative k-medoid clustering process as taught by Aggarwal because it avoids loss of information (Aggarwal, col. 2, lines 26-28) and ensures the highest quality clusters are detected (Aggarwal, col. 6, lines 1-2).

As to claim 8, Menon further discloses the observation likelihood functions are iteratively updated while tracking patterns in the target data (col. 8, line 65 thru col. 9, line 47, Menon teaches the observation histogram is updated according to the accumulation rule and the correlation of the testing data.)

Claim 11 recites, the system of claim 1, wherein the target data is space-based data, and wherein probabilistically tracking at least one pattern in the target data comprises tracking at least on pattern in a space domain.

Menon discloses the test data (tracking data) can be a snapshot of a subject (col. 8, lines 62-64). A snapshot of a subject does not vary in time (unlike an image sequence) thus it is considered space-based data. The system of Menon does not disclose performing any form of transformation on the inputted data therefore the pattern recognition/classification (tracking) of the subject is understood as being in space domain.

As to claim 12, Menon discloses the target data is a sequence of images, and wherein probabilistically tracking at least one pattern in the target data comprises tracking at least on pattern in the sequence of images (col. 8, line 62-64, Menon teaches the data can be multiple frames of data such as real-time video).

Claims 3,14,15,16,22,32,33,34,36,37 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Menon and Aggarwal as applied to claim 1 above, and further in view of U.S. Patent Application Publication 2003/0123737 to Mojsilovic et al. (Mojsilovic).

As to claim 3, the combination Menon and Aggrawal does not disclose generating the observation likelihood functions comprises using a multidimensional scaling process to estimate a dimensionality of each exemplar cluster. However, Mjsilovic teaches multidimensional scaling for interpreting and labeling dimensions (page 5, paragraphs 0047-0048).

The teachings of Menon, Aggarwal and Mojsilovic are combinable because multidimensional scaling is often used in combination with clustering techniques (Mojsilovic, page 5, paragraph 0050). It would have been obvious to one of ordinary skill in the art at the

time the invention was made for the system taught by the combination of Menon and Aggarwal to perform multidimensional scaling as taught by Mojsilovic because multidimensional scaling uncovers hidden structures in data (Mojsilovic, page 5, paragraph 0047) and is also useful to indicate which particular features are important (Mojsilovic; page 5, paragraph 0048).

As to claim 14, the combination of Menon and Aggarwal further discloses a method (Menon, col. 1, line 30) for generating a set of observation likelihood functions from a set of exemplars comprising:

Deriving more than one exemplar from at least one set of training data to create a set of exemplars (see remarks presented above for claim 1);

Iteratively cluster similar exemplars from the set of exemplars around selected exemplars to form an exemplar cluster for each selected exemplar (see discussion presented above for claims 1 and 2);

Estimate a dimensionality for each of the exemplar clusters (see remarks presented above for claim 3);

Compute an observation likelihood function for each exemplar cluster based on the dimensionality of each exemplar cluster (see remarks presented above for claim 3).

Menon is silent with regard to using a computer, however, the data processing system described by Mojsilovic is clearly a computer (page 3, paragraphs 0032 and 0033). It would have been obvious to one of ordinary skill in the art at the time the invention was made to implement the method using a computer as taught by Mojsilovic because the method involves significant amounts of inputted and stored data and complex mathematical calculations which are more effectively implemented on a computer.

Menon does not disclose randomly selecting more than one exemplar from the set of exemplars, however, Aggarwal further teaches the initial set of medoids may be generated at

random (col. 5, lines 24-28). It would have been obvious to one of ordinary skill in the art at the time the invention was made to select random exemplars as taught by Aggarwal in order to avoid an loss of information that may be incurred by selecting feature sets in advance (Aggarwal, col. 2, lines 26-34).

Menon does not disclose estimating the dimensionality for each of the exemplar clusters based on the minimum distance between exemplars in each exemplar cluster. However, Aggarwal teaches minimizing the average segmental distance (average distance between the medoid and exemplars in the cluster) (col. 5, lines 45-55). It would have been obvious to one of ordinary skill in the art at the time the invention was made to compute the minimum distances between exemplars in each exemplar cluster as taught by Aggarwal because it ensures the best set of medoids and highest quality clusters (Aggarwal, col. 6, lines 1-2) before estimating the dimensionality for each of the exemplar clusters.

As to claim 15, Menon recites "As each training pattern is received, a correlation or distance is computed between it and each of the existing categories." This clearly implies correlation (similarity) is determined by distance between the patterns. With regard to computing the minimum distance between exemplar in the set of exemplars and each of the randomly selected exemplars, please refer to arguments presented above for claim 14.

As to claim 16, Menon discloses the training data is image data (col. 6, lines 35-46).

As to claim 22, arguments analogous to those presented for claim 1 above are applicable to claim 22.

As to claim 32, arguments analogous to those presented for claims 1 and 2 above are applicable to claim 32, with the exception of a computer-readable medium having computer executable instructions.

Menon is silent with regard to a computer readable medium. However, the data processing system described by Mojsilovic is clearly a computer (page 3, paragraphs 0032 and 0033). Included within the data processing system is memory, which may include RAM, ROM, removable disks or tape, storing a program containing program instructions (page 3, paragraph 0032). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have a computer-readable medium encoded with a computer program as taught by Mojsilovic for causing a computer to perform the method as taught by Menon and Aggarwal. It is well known that computer programs are stored on computer readable mediums such as disks and tapes because they provide safe, high capacity storage.

As to claim 33, arguments analogous to those presented above for claims 2 and 24 are applicable to claim 33.

As to claim 34, further teaches a correlation (distance) function is performed between the input feature and the category (Equation 1).

As to claim 36, arguments analogous to those presented for claim 11 above are applicable to claim 36.

As to claim 37, arguments analogous to those presented for claim 12 above are applicable to claim 37.

Claims 4,5,9 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Menon and Aggarwal as applied to claim 1 above, and further in view of U.S. Patent 5,867,584 to Hu et al. (Hu).

As to claim 4, Menon discloses the training data is image data (col. 6, lines 35-46), but does not disclose contour-based exemplars are extracted from the training data using conventional edge detection techniques to process the training data. However, Hu teaches

using an edge detection method and creating an edge image of the object (col. 6, lines 55-60) in method for object tracking in a video sequence.

The teachings the Hu and the combination of Menon and Aggrawal (specifically Menon) are combinable because they are both concerned with identifying objects in image data. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have the system as taught by the combination Menon and Aggarwal extract contour-based exemplars from the training data using conventional edge detection as taught by Hu. One would have been motivated to do so because edge detection is useful for differentiating the foreground objects from the background objects of an image and would improve identification of the objects to be extracted as contour-based exemplars.

As to claim 5, Menon further discloses the contour based exemplars are used for probabilistically tracking at least one object in a sequence of images (col. 8, line 62-64, Menon teaches the data can be multiple frames of data such as real-time video).

As to claim 9, the combination of Menon and Aggarwal does not disclose the exemplars are contour-based exemplars (arguments analogous to those presented for claim 5 are applicable to claim 9), and wherein the computed distance between exemplars is a chamfer distance. However, Hu teaches a chamfer distance calculation (col. 6, lines 48-50).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to compute the distance between the contour-based exemplars as a chamfer distance. A chamfer distance measures the distances between each point on a curve and its closest point on another curve and would be useful in determining an overall distance between the two curves, thus providing a good measurement of similarity between contour-based exemplars and aiding in the creation of high quality (exemplars within a cluster being very similar) clusters.

Claims 6,7,10 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Menon and Aggarwal as applied to claim 1 above, and further in view of U.S. Patent Application Publication 2003/0026483 to Perona et al. (Perona).

As to claim 6, Menon discloses the training data is image data (col. 6, lines 35-46), but does not disclose image patches representing target objects of interest are extracted as exemplars from the training data. However, Perona teaches extracting image patches from training data (page 1, paragraph 0018; page 2, paragraph 0029)

The teachings of Menon, Aggrawal and Perona are combinable because they are all concerned with clustering data. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have the system taught by the combination of Menon and Aggarwal extract image patches representing target object of interest as exemplars from the training data as taught by Perona. One would have been motivated to do so because such exemplars are useful in classifying what is background clutter and what are foreground objects (Perona, page 1, paragraph 0020)

As to claim 7, Menon further discloses the exemplars are used for probabilistically tracking at least one object in a sequence of images (col. 8, line 62-64, Menon teaches the data can be multiple frames of data such as real-time video).

Claim 10 recites, "The system of claim 2 wherein the exemplars are image patch-based exemplars, and wherein the computed distance between exemplars is a shuffle distance." Examiner interprets a shuffle distance as a distance between images or image patches. With regard to the exemplars being image patch-based, arguments analogous to those presented for claim 6 above. Thus if the combination of Menon, Aggarwal and Perona is made as discussed in claim 6, the distances calculated by Menon (col. 1, lines 38-43) would be considered shuffle distances, as they would be distances between image patch-based exemplars.

Claims 17 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Menon, Aggarwal and Mojsilovic as applied to claims 14 and 16 above, and further in view of Hu.

As to claim 17, arguments analogous to those presented for claim 5 above are applicable to claim 17.

As to claim 18, arguments analogous to those presenting for claim 9 above are applicable to claim 18.

Claims 19, 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Menon, Aggarwal and Mojsilovic as applied to claims 14 and 16 above, and further in view of Perona.

As to claim 19, arguments analogous to those presented for claim 6 above are applicable to claim 19.

As to claim 20, arguments analogous to those presented for claim 10 above are applicable to claim 20.

Claims 21,23,24,25,28,31 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Menon, Aggarwal, Mojsilovic as applied to claims 1 and 14 above, and further in view of the paper “Real-Time Object Detection for “Smart” Vehicles” by Gavrila and Philomin (Gavrila).

As to claim 21, Menon is silent with regard to aligning the exemplars prior to iteratively clustering the exemplars. However, Garvila teaches translating, rotating and scaling a template (contour-based exemplar) in order to properly position it over an image (aligning) before matching (page 1, col. 2, lines 36-42).

The teachings of Menon, Aggarwal, Mojsilovic, and Gavrila are combinable because they are all concerned with clustering of data. It would have been obvious to one of ordinary skill in the art at the time the invention was made for the process as taught by the combination of Menon, Aggarwal and Mojsilovic to include aligning the exemplars as taught by Gravila. One would be motivated to do this in order more effectively cluster the exemplars and reduce the number of iterations.

As to claim 23, arguments analogous to those are presented in claims 1 and 14 above are applicable to claim 23, however, Menon, Aggarwal, and Mojsilovic do not teach clustering exemplars based on a minimization of a maximum distance between exemplars. However, Gavrila teaches calculating the maximum distance between a template (center exemplar) and the elements (exemplars) (page 3, col. 2, lines 23-27; Equation 4), then minimizing an objective function, which is a sum of the max distances for each cluster (page 4, col. 1, lines 1-4, Equation 6), thus minimizing a maximum distance between exemplars.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to cluster exemplars based on a minimization of a maximum distance between exemplars as taught by Gavrila because it results in tight groupings and lowers the distance threshold needed during matching (classification/identification or target data) (Gavrila, page 4, col. 1, lines 18-23)

As to claim 24, extracting parameters from the training data that are statistically representative of at least one target pattern is inherent to a clustering process implemented in an object tracking/recognition system.

As to claim 25, arguments analogous to those presented for claim 2 above are applicable to claim 25.

As to claim 28, arguments analogous to those presented claims 1 and 3 are applicable to claim 28.

As to claim 31, Menon does not disclose the exemplars are geometrically transformed in Euclidian space in order to align the exemplars prior to clustering the exemplars. Arguments analogous to those presented for claim 21 above are applicable to claim 31. It is understood that the transforms performed by Gavrila are in Euclidian space (a vector space with real numbers).

Claims 26,27 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Menon, Aggarwal, Mojsilovic and Gravila as applied to claim 23 above, and further in view of U.S. Patent 5,519,789 to Etoh.

As to claim 26, the combination of Menon, Aggarwal, Mojsilovic and Gravila, do not disclose estimating a dimensionality for each cluster of exemplars comprises fitting a chi-squared distribution to a distribution of distances from the representative exemplar at the center of each cluster to each of the other exemplars in that cluster. However, Etoh teaches fitting a chi-square distribution to the difference of sample vectors and a class mean in an image clustering apparatus.

The teachings of Menon, Aggarwal, Mojsilovic, Gravila and Etoh are combinable because they are all concerned with clustering of data. It would have been obvious to one of ordinary skill in the art at the time the invention was made to fit a chi-squared distribution as taught by Etoh to the distances from the representative exemplar at the center of each cluster to each of the other exemplars as taught by the combination of Menon, Aggarwal, Mojsilovic and Gravila. Motivation for doing so can be seen in the observation histograms of Menon (Figures 1-5). It would have been obvious to one of ordinary skill in the art that the histograms' skewed

distributions resemble a chi-squared distribution (Walpole, page 130, Figure 4.21) rather than a normal Gaussian distribution.

As to claim 27, a chi-squared distribution is a special case of a gamma distribution (Walpole, page 131). Therefore, arguments analogous to those presented for clam 26 above are applicable to claim 27.

Claim 29 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Menon, Aggarwal, Mojsilovic, and Gavrila as applied to claim 23 above, and further in view of Hu.

As to claim 29, arguments analogous to those presented for claim 9 are applicable to claim 29.

Claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Menon, Aggarwal, Mojsilovic, and Gravila as applied to claim 23 above, and further in view of Perona.

As to claim 30, arguments analogous to those presented for claim 10 are applicable to claim 30

Claim 35 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Menon, Aggarwal, Mojsilovic as applied to claim 32 above, and further in view of Etoh and the book "Probability and Statistics for Engineers and Scientist" by Walpole and Myers (Walpole).

As to claim 35, arguments analogous to those presented in claims 26 and 27 above are analogous to claim 35. With regard to an exponential constant, an exponential constant is

inherent to the chi-squared and gamma distributions (Walpole, pages 129 and 130). $e \approx 2.718$ is commonly referred to as the exponential constant

Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Menon and Aggarwal as applied to claim 1 above, and further in view of U.S. Patent 5,389,790 to Honey et al. (Honey).

As to claim 13, Menon and Aggarwal are silent with regard to the target data being frequency-based data, wherein probabilistically tracking at least one pattern in the target data comprises tracking at least one pattern in a frequency domain. However, Honey teaches object detection and identification of objects based on frequency patterns unique to the object. (col. 1, lines 5-10).

The teachings of Menon, Aggarwal and Honey are combinable because they are all concerned with the classification/identification of data. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have the system disclosed by the combination of Menon and Aggarwal include target data which is frequency based and tracking a pattern in the frequency domain as taught by Honey. One would have been motivated to do so in order to identify objects emitting electromagnetic radiation and frequency fluctuations that cannot be detected by the human eye (Honey, col. 1, lines 24-33).

Claim 38 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Menon, Aggarwal and Mojsilovic as applied to claim 32 above, and further in view of Honey.

As to claim 38, arguments analogous to those presented for claim 13 above are applicable to claim 38.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

U.S. Patent 6,314,204 to Cham et al. is cited for teaching fitting Gaussian distributions to likelihood functions for determining the probable state of a moving object in images.

U.S. Patent 5,983,224 to Singh et al. is cited for teaching clustering of data using a k-medoid method.

U.S. Patent Application Publication 2003/0099401 to Driggs et al. is cited for teaching pattern recognition using a classification method.

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anthony Mackowey whose telephone number is (703) 306-4086. The examiner can normally be reached on M-F 9:00-6:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amelia Au can be reached on (703) 308-6604. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

AM
3/11/2005

Jon Chang

Jon Chang
Primary Examiner